AD-A216 515

DTIC FILE COPY

(2)

REPORT DOCUMENTATION PAGE

DTIC ELECTE JAN 05 1990 S D

1a. REPORT SECURITY CLASSIFICATION	Unclassified
1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY	---
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	N/A
3. DISTRIBUTION/AVAILABILITY OF REPORT	Approved for public release; distribution unlimited
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
5. MONITORING ORGANIZATION REPORT NUMBER(S)	AFOSR-TR- 89-1729
6a. NAME OF PERFORMING ORGANIZATION	Institute for Physical Science & Technology/University of Maryland
6b. OFFICE SYMBOL (If applicable)	
7a. NAME OF MONITORING ORGANIZATION	AFOSR, Dept. of Mathematics and Information Sciences
6c. ADDRESS (City, State and ZIP Code)	College Park, Maryland 20904
7b. ADDRESS (City, State and ZIP Code)	Bolling Air Force Base Washington, D.C. 20332
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	AFOSR
8b. OFFICE SYMBOL (If applicable)	
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	AFOSR-83-0286
8c. ADDRESS (City, State and ZIP Code)	Bldg. 410 Bolling AFB, D.C. 20332

10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
61102F	2304	A5	

11. TITLE (Include Security Classification)	RESEARCH EQUIPMENT
12. PERSONAL AUTHOR(S)	R.B. Kellogg
13a. TYPE OF REPORT	Final
13b. TIME COVERED	FROM 9/1/83 TO 1/31/85
14. DATE OF REPORT (Yr., Mo., Day)	85/3/25
15. PAGE COUNT	6
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Numerical analysis, finite elements, continuation, scattering

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The purpose of the report was to provide additional equipment for a computational laboratory dedicated to research in numerical analysis and applied mathematics. The report summarizes the equipment acquired and the research being presently carried out in the laboratory. The research is on topics in boundary integral equations, adaptive finite elements, numerical methods for a scattering problems, continuation methods, and very accurate arithmetic calculations. (KR)

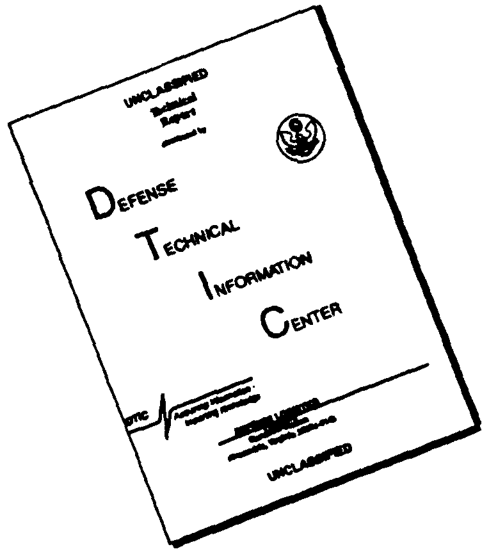
90 01 04 046

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐
21. ABSTRACT SECURITY CLASSIFICATION	Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL	Dr. Robert N. Buchal
22b. TELEPHONE NUMBER (Include Area Code)	(202)767-4939
22c. OFFICE SYMBOL	NM

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

Unclassified
SECURITY CLASSIFICATION OF THIS PAGE

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

AFOSR-TR- 89-1729

Final Report

Grant AFOSR 83 0286

1 September 1983 - 31 January 1985

Title

RESEARCH EQUIPMENT

Principal Investigator

R. Bruce Kellogg

University of Maryland
College Park, MD 20742

Final Report for Equipment Grant AFOSR-83-0286, Sept. 1,1983 - Jan. 31, 1985

The purpose of the grant was to provide additional equipment for a computational laboratory dedicated to research in numerical analysis and applied mathematics. The initial funding for the laboratory was provided by the National Science Foundation.

The funds provided by this grant were used to acquire an additional computational node, and additional memory, communications capabilities, and graphics capabilities for the laboratory. A detailed list of the equipment acquired by this grant is as follows.

ITEM	AMOUNT
Apollo DN300 -1MB computational node	$25400
Winchester disk for an Apollo node	5390
Hewlitt Packard pen plotter and graphics terminals	7724
3 CRTs, cable Source	2118
3 print terms Federal	3009
5 Password modems	1753
power equalizer	310
printer ribbons,diskettes	410
symbolic manipulation program and UNIX	2734
textronixs terminal emulator and PLOT10 software	1811
miscellaneous, shipping charges,etc.	358
TOTAL	$55317

Following are brief descriptions of the research being carried out in the computational laboratory.

Chief, [illegible]

Project: Implementation of the spline-trigonometric method

Investigator: Douglas N. Arnold (Department of Mathematics)

A method designed by the investigator for the numerical solution of boundary integral equations is being implemented and tested. The method is a Galerkin method with spline trial functions and trigonometric test functions. Among the issues being investigated are the proper numerical quadrature procedures to use with the spline-trig method, the use of the fast Fourier transform in the implementation, the dependence of the convergence on the shape of the domain, and the local convergence behavior. At present a first version of the code has been written.

This work is partially supported by the National Bureau of Standards.

Project: Numerical methods for scattering

Investigators: R. B. Kellogg (IPST)

A. K. Aziz (IPST)

Numerical methods are being investigated for the solution of time harmonic scattering problems for moderately high frequencies, betweem the high frequency region where geometric optics techniques prevail and the low frequency region where the usual finite element and finite difference techniques are appropriate. The present stage of the investigation involves the testing, on a model problem, of some modified finite element schemes that incorporate rapidly oscillating functions into the finite element subspace.

This result is supported in part by the navy, through the IR fund of NSWC.

Project: Path following algorithms.

Investigator: R. B. Kellogg (IPST)

Numerical methods are being developed and studied for the solution of n equations in n + 1 unknowns. A path following program has been written, and is being tested on various problems using the Apollo system. The present stage of the project involves using the program to follow curves generated by the reduced solution of a rather complicated singular perturbation problem for a system of differential equations. with several boundary layers. The problem arises in the modelling of certain transport processes in physiology.

Project: Adaptive approaches and a-posteriori estimates for solving differential equations

Investigator: Ivo Babuska

The work is partially supported by ONR Contract No. 00014-85-K-0169 and NSF Grant DMS-8315316

1) The p and h-p versions of the finite element method.

The theory of the p and h-p versions of the finite element method in one and two dimensions was developed. The practical applicability of the theoretical conclusions was tested by the numerical treatment of relatively large scale problems of structural mechanics. The results have been already used in the commerical p-version finite element program PROBE (Noetic Technologies, Inc.). The numerical results are part of two Ph.D. theses awarded in 1985.

2) Numerical solution of linear and nonlinear boundary value problems for ordinary differential equations.

The theory of the factorization method was developed and a general program was written. The program was tested on various problems of an engineering character as, for example, the problem of the stability of a towed underwater cable. The results are related to the Ph.D. theses awarded in 1984.

3) Adaptive finite element solution for nonlinear problems.

The previous work, which resulted in the design and implementation of the adaptive solver FEARS for linear partial differential equations, is being extended to the design of the nonlinear solver NFEARS.

Project: Level-index arithmetic

Investigators: F. W. J. Olver (Research Professor, IPST) and D. W. Lozier (Adjunct Professor, IPST).

The level-index (ℓi) number system is being investigated as an alternative to the floating-point system for internal use on computers. In this system a nonnegative real number x is represented as its generalized logarithm $\ell + \ell n^{(\ell)} x$, where $\ell n^{(\ell)} x$ is the ℓ th iterated logarithm of x, the integer ℓ being determined by the condition $0 \leq \ell n^{(\ell)} x < 1$. The main advantage of the ℓi system would be to eliminate overflow and underflow problems. The Apollo will be used to simulate the ℓi system in software in order to test the performance of the system on various standard algorithms in numerical analysis, particularly ones that are known to be prone to overflow or underflow. A compiler is nearing completion.

This work is supported in part by the U. S. Army Research Office, Durham under Contract DAAG 29-84-K-0022.

Reference: C. W. Clenshaw and F. W. J. Olver "Beyond floating point", J. A.C.M. 31, 319-328 (1984).